Effect of Recycled Aggregate Concrete with Glass Fiber on Concrete Properties

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor Degree of B. Eng (hons.) Civil Engineering

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRACT

Waste materials have becoming an issue worldwide nowadays. From construction to transportation, all these wastes contribute to serious environmental problem. Therefore, an urgent need of an alternative in reducing the waste is highly recommended. In this study, recycle aggregate concrete (RAC) obtained from crushed concrete and glass fiber are used in the concrete mix. Furthermore, concrete made from glass fiber and recycled coarse aggregate as partial replacement of coarse aggregate is studied for workability, compressive and flexural strengths. In this study, recycled coarse aggregate used as partial replacement of coarse aggregate by percentage replacement 20% with natural aggregate. Glass fiber was used to replaced 1 % and 2 % of the total weight of cement. This study concentrated on the workability, compressive strength and flexural strength of the RAC with different percentage of glass fiber. One test was conducted for workability of fresh RAC namely slump test. Meanwhile, cubes were subjected to compressive strength test and beams were subjected to flexural strength test. All the specimens were cured in water for 7and 28 days. The results indicated that the fresh RAC exhibit a significant decrease in workability with increasing percentage of glass fiber. However, the strength of the recycle aggregate concrete is increasing with increased percentage of glass fiber. This is due to the physical properties of the RAC and glass fiber. In general, the results suggested that the glass fiber used to replace the cement should be more than 2 % in order to achieve higher strength.

ABSTRACT

Bahan-bahan buangan telah menjadi isu di seluruh dunia pada masa kini. Dari pembinaan ke pengangkutan, semua sisa ini menyumbang kepada masalah alam sekitar yang serius. Oleh itu, keperluan mendesak alternatif dalam mengurangkan sisa sangat disyorkan. Dalam kajian ini, konkrit agregat kitar semula (RAC) yang diperoleh daripada konkrit dan serat kaca dihancurkan digunakan dalam campuran konkrit. Selain itu, konkrit yang diperbuat daripada gentian kaca dan agregat kasar yang dikitar semula sebagai penggantian sebahagian daripada agregat kasar dikaji untuk kebolehkerjaan, kekuatan mampatan dan lenturan. Dalam kajian ini, agregat kasar yang dikitar semula digunakan sebagai penggantian sebahagian daripada agregat kasar oleh penggantian peratusan sebanyak 20% dengan agregat semulajadi. Serat kaca digunakan untuk menggantikan 1% dan 2% daripada jumlah berat simen. Kajian ini tertumpu pada kebolehkerjaan, kekuatan mampatan dan kekuatan lenturan RAC dengan peratusan serat kaca yang berlainan. Satu ujian telah dijalankan untuk kebolehlaksanaan RAC segar iaitu ujian kemerosotan. Sementara itu, kiub tertakluk kepada ujian kekuatan mampatan dan balok dikenakan ujian kekuatan lenturan. Semua spesimen telah sembuh di dalam air selama 7and 28 hari. Hasilnya menunjukkan bahawa RAC segar mempamerkan penurunan ketara dalam kebolehpasaran dengan peningkatan peratusan serat kaca. Walau bagaimanapun, kekuatan konkrit agregat kitar semula meningkat dengan peningkatan peratusan gentian kaca. Ini disebabkan sifat fizikal RAC dan serat kaca. Secara umum, keputusan menunjukkan bahawa serat kaca yang digunakan untuk menggantikan simen perlu lebih daripada 2% untuk mencapai kekuatan yang lebih tinggi.

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LIST OF ABBRREVIATIONS

BS	British Standard European Norm
ACI	American Concrete Institute
ASTM	American Standard Test Method
POC	Ordinary Portland Cement
RAC	Recycled Aggregate Concrete
RAC0	Recycled Aggregate Concrete with 0% Glass Fiber
RAC1	Recycled Aggregate Concrete with 1% Glass Fiber
RAC2	Recycled Aggregate Concrete with 2% Glass Fiber
RC	Reinforced Concrete

LIST OF SYMBOLS

N/mm2	Newton per millimeter square
KN	Kilonewton
N	Newton
mm	Millimeter
m	Meter
MPa	Megapascal
Kg	Kilogram

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

Demolition of old and deteriorated buildings and traffic infrastructure, and their substitution with new ones, is a frequent phenomenon today in a large part of the world. The main reasons for this situation are changes of purpose, structural deterioration, rearrangement of a city, expansion of traffic directions and increasing traffic load, natural disasters (earthquake, fire and flood)(Malešev, Radonjanin, & Marinković, 2010)

Recycled aggregate (RA) is aggregate resulting from the processing of inorganic material previously used in construction. According to the European Standards for concrete there is a full possibility for the use of RA in concrete. The acceptable ways for the use must be determined nationally, i.e. according to the national specifications. As RA can include all kind of inorganic materials from the C&D waste, i.e. concrete, concrete masonry units, mortars, aerated concrete and also clay masonry units (bricks and tiles), it is not as good a material for concrete production as recycled aggregate concrete (RAC). RCA is made of solely crushed concrete. Separation of concrete material already during the demolition phase is essential to make it easier to produce good quality RCA.(Kuosa, 2012)

Malaysia is expected to exceed 15,000 tons of solid wastes generation daily. The major solid wastes are generated in Malaysia from agricultural, industrial, municipal and mining sources. The disposal of these wastes has become a major environmental problem in Malaysia and thus the possibility of recycling the solid wastes for use in construction materials is of increasing importance.(Safiuddin, Jumaat, Salam, Islam, & Hashim, 2010). Presently, a huge amount of waste is generated in construction sites. The estimated total construction waste generated from a project site during the construction of a new building is around 27,068.40 tonnes.(Ismail, Hoe, & Ramli, 2013).

Some benefits of using RCA are illustrated below:

1) Controlling the over-discharge of construction and demolition wastes that otherwise would have been disposed in landfills.

2) Decreasing the dependence of the construction industry on natural aggregates, thereby preserving natural resources, provides savings from the treatment of waste disposal, and yields alternative sources for urban areas facing shortage of natural aggregates.

3) Cost reduction where the availability of recycled aggregate as an alternative can provide balance and control of the price of aggregate in the market, which has continued to increase due the depletion of the natural aggregate supply.

Therefore, it can be modified with fiber so as to enhance its properties. In this research, glass fiber is taken into consideration for this purpose.

In general, some fibers are lower in the strength of recycled aggregate and some fiber provides greater impact, abrasion and shatter resistance. However, this can refer to the type of fiber reinforced with the RAC. In fact, there are many types of fiber can be used such as steel, glass, synthetic and natural fibers.

Glass fiber as a kind of low cost material has many properties similar with carbon fiber, such as good thermal stability, good chemical corrosion resistant and better mechanical strength.(Zuo, Chen, Luo, & Chen, 2015)

Glass fibers, also known commercially as ‘fiberglass’, are most extensively use reinforcements for polymer matrix composites due to their combination of low cost, high strength and relatively low density. Unlike carbon or Kevlar fibers glass fibers are isotropic thus avoiding loss of properties when loaded in the transverse direction. Fiberglass is produced by pulling molten glass through orifices at a temperature where the glass has just the right amount of viscosity.

1.2 PROBLEM STATEMENT

These days, the recycled concrete is obtained through the demolition of concrete elements of buildings, roads, bridges, and other structures, also it comes from the residue of fresh and hardened rejected units in precast concrete plants.

Recycled aggregate concrete works as alternative of natural resources which is in shortage. RCA it has a range of environmental and economic benefits such as it reduces the space required for the landfill disposal. Recently, the major challenge that our society communities facing is that recycling will help to conserve natural resources for next generations where the natural resource protection is one of the important parts of environmental issues. The recycling of concrete waste into recycled aggregate concrete (RAC) has been investigated as a potential source of construction concrete.

In an increasingly urban world, the growth in waste generation, particularly in construction and demolition waste. Environmental problems resulting from CDW disposal are a cause for concern because of the impacts that illegal disposal sites (which occur routinely) have on cities and their surroundings. This issue has been extensively debated and has stimulated interest in environmentally sustainable solutions. In this context, environmental legislation has become stricter, with a tendency to make waste generators responsible for their own waste, ultimately leading to the adoption of waste minimization and recycling policies. In Malaysia, the local environment is affected by a great amount of concrete waste this is due to the limitation of disposal sources and the renovation of buildings. In recent years, a popular topic has been researched by many researchers which is the replacement of the natural aggregates at the concrete production through the use of recycled aggregates. Thus, it is so important that coming up with new methods and strategies for replacement and use a proper additive such as glass fiber.

In this research, glass fiber is proposed to be used as an additive. This is due to the glass fiber composites strength/weight ratios are higher than those of most other materials and their impact resistance is phenomenal. Further they possess resistance to moisture and outdoor weathering and resistance to heat and chemicals. These properties are coupled with ease of fabrication.

REFERENCES

Acob, A., & John, E. (2016). Mechanical Properties of Glass Fiber Reinforced Concrete Using Recycled Concrete, 17070–17076.

Cook, M. D., Ley, M. T., & Ghaeezadah, A. (2014). A workability test for slip formed concrete pavements.Construction and Building Materials, 68, 376–383.

Giwa, A., Isa, M. T., & Idris, U. A. (2013). Analysis of Some Physical and Mechanical Properties of Selected Fabrics, 2(3), 49–58.

Gornale, A., Ibrahim Quadri, S., Mehmood Quadri, S., Md Akram Ali, S., & Shamsuddin Hussaini, S. (2012). Strength Aspects of Glass Fibre Reinforced Concrete. International Journal of Scientific & Engineering Research, 3(7), 3–7.

Harcourt, P. (2012). Flexural And Tensile Strength Properties Of Concrete Using Lateritic Sand And Quarry Dust As Fine Aggregate, 7(3), 324–331.

Ismail, S., Hoe, K. W., & Ramli, M. (2013). Sustainable Aggregates: The Potential and Challenge for Natural Resources Conservation. Procedia - Social and Behavioral Sciences, 101(February 2014), 100–109.

Jacob, A., & John, E. (2016). Mechanical Properties of Glass Fiber Reinforced Concrete Using Recycled Concrete, 17070–17076.

Junak, J., Stevulova, N., Junak, J., & Stevulova, N. (2013). Natural Aggregate Replacement India: American Society of Civil Engineers.

Kourd, E. A. Al, & Hammad, E. A. (2010). Cement And Concrete Technology. International Journal of Physical Sciences, 5(13), 1952–1963.

Kuosa, H. (2012). Reuse of recycled aggregates and other C&D wastes. Kerala , India: American Society of Civil Engineers.

Malešev, M., Radonjanin, V., & Marinković, S. (2010). Recycled concrete as aggregate for structural concrete production. (Vol. ELSEVIER). Pradesh , India.

Moore, W. M. (2010). Concrete works. Building Rural Roads, 388–466.

Pickel, D. (2014). Recycled Concrete Aggregate: Influence of Aggregate Pre-Saturation and Curing Conditions on the Hardened Properties of Concrete.

Rakshith, A. (2013). Strength and Permeability Characteristics. Kerala , India: American Society of Civil Engineers.

Rao, K. S., Rakesh, S., & Narayana, A. L. (2013). Comparison of Performance of Standard Concrete And Fibre Reinforced Standard Concrete Exposed To Elevated Temperatures, (03), 20–26.

Safiuddin, M., Jumaat, M. Z., Salam, M. A., Islam, M. S., & Hashim, R. (2010). Utilization of solid wastes in construction materials. International Journal of Physical Science.

Standard, B. (1983). BS 1881 :Partlll: 1983.

Standard, B. (1983). Testing concrete.

Standard, I. (2009). Testing hardened concrete – Part 3 : Compressive strength of test specimens.

Testing concrete. (1983).

Tiwari, N. (2015). Introduction to Composite Materials and structures. 1950-1975. Journal of engineering for concrete. 121(3): 540-545.

Younoussa Millogo (2013). Comparison of Performance of Standard Concrete Brazil: Journal of Scientific & Engineering Research.

Zuo, J., Chen, S., Luo, C., & Chen, D. (2015). Preparation of electroless copper coated glass fiber and piezoresistive properties of copper coated glass fiber reinforced plastics. Ghana: Applied Surface Science.